

Assessment of Mediterranean buffalo lactation curves shape using lactation models

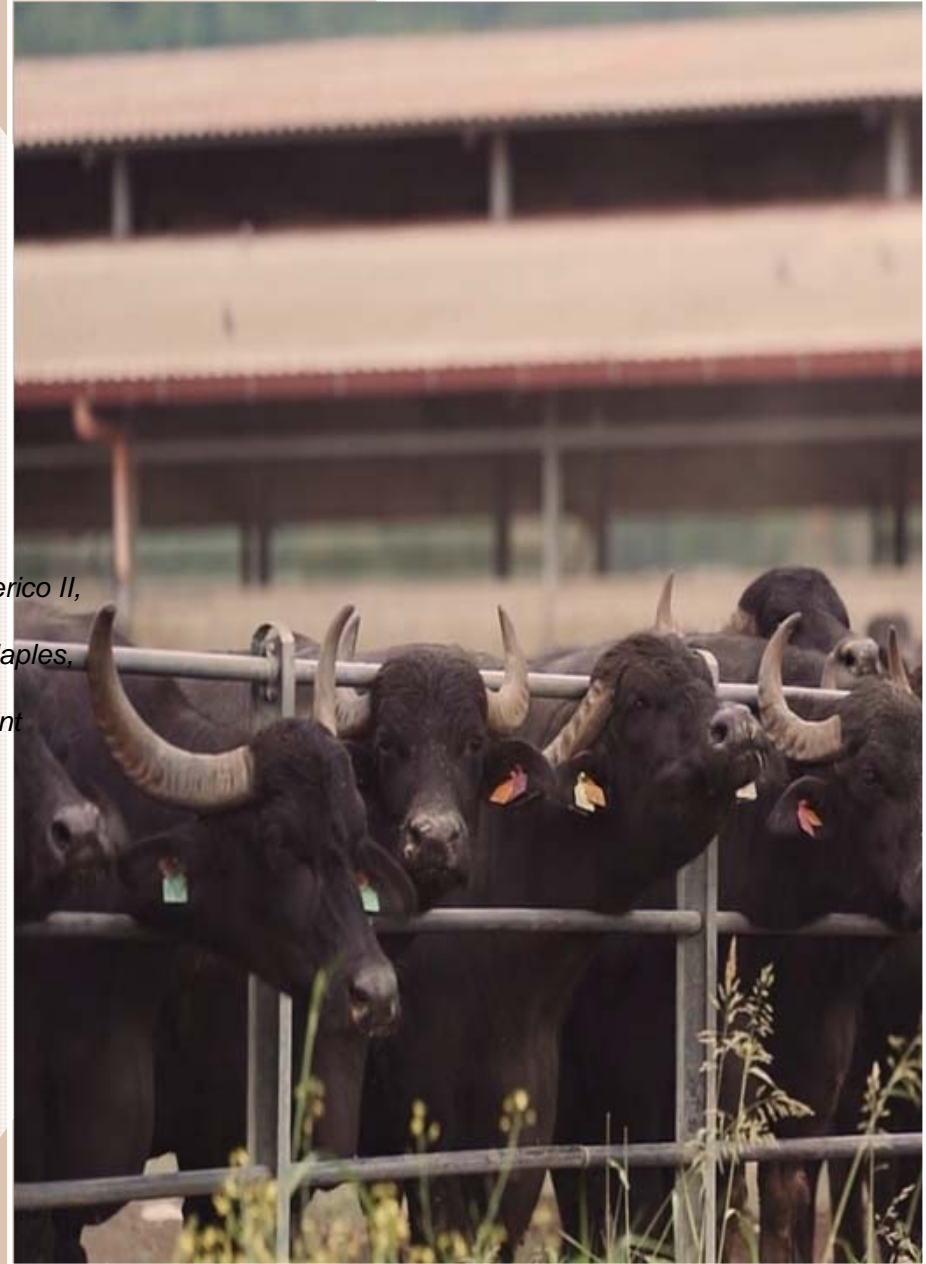
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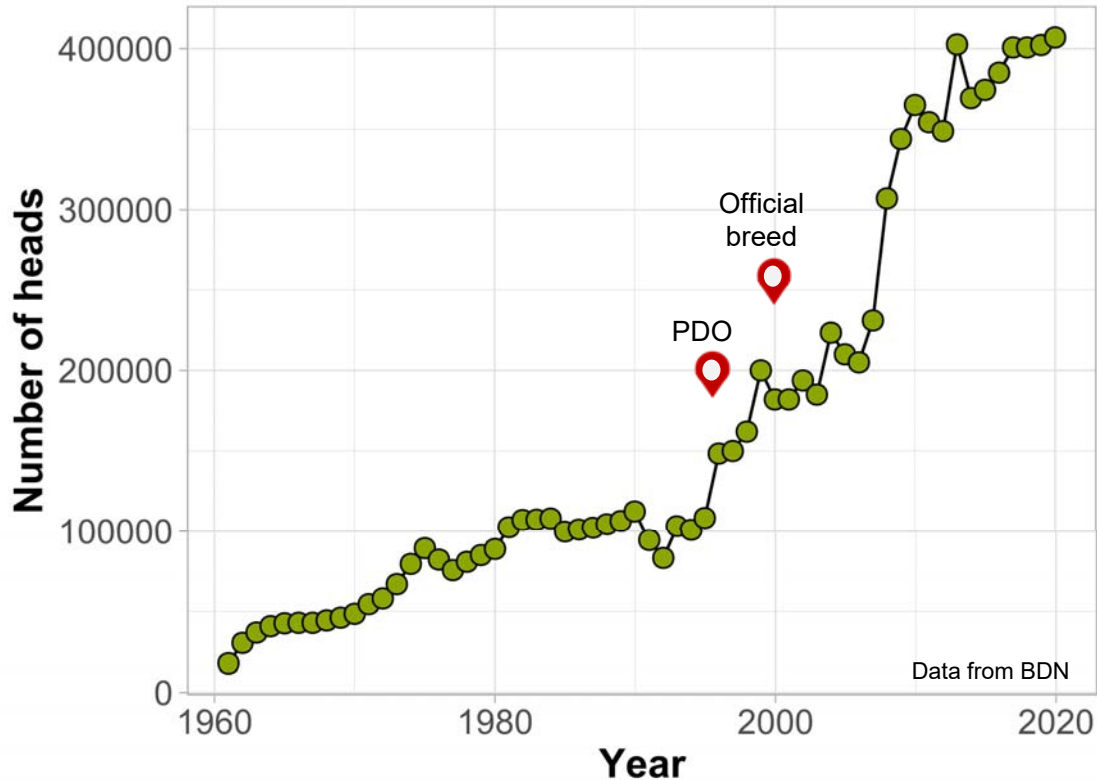
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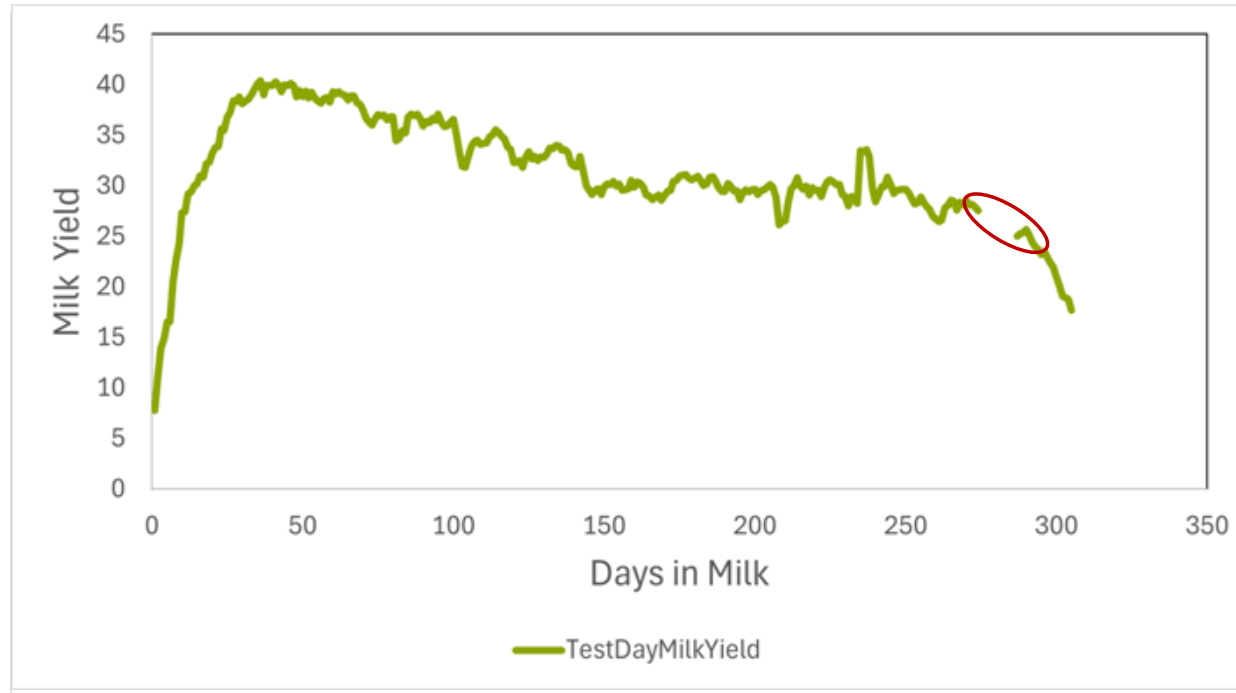
Background 1

- Buffalo sector has been constantly growing in the last years and are important producers of milk and dairy products
- From 1996 until now, there has been a growth of 173%. The number of buffalos in Italy amounts to about 430000



- 1996 ● Mozzarella cheese as a «PDO» product.
- 2000 ● «Bufala Mediterranea Italiana» as a official breed
- 2023 ● Mozzarella cheese is the fourth best-selling of all Italian «PDO» production

- Lactation Curve (LC) is graphic representation of milk yield during the length of one lactation



Total milk yield
Daily milk

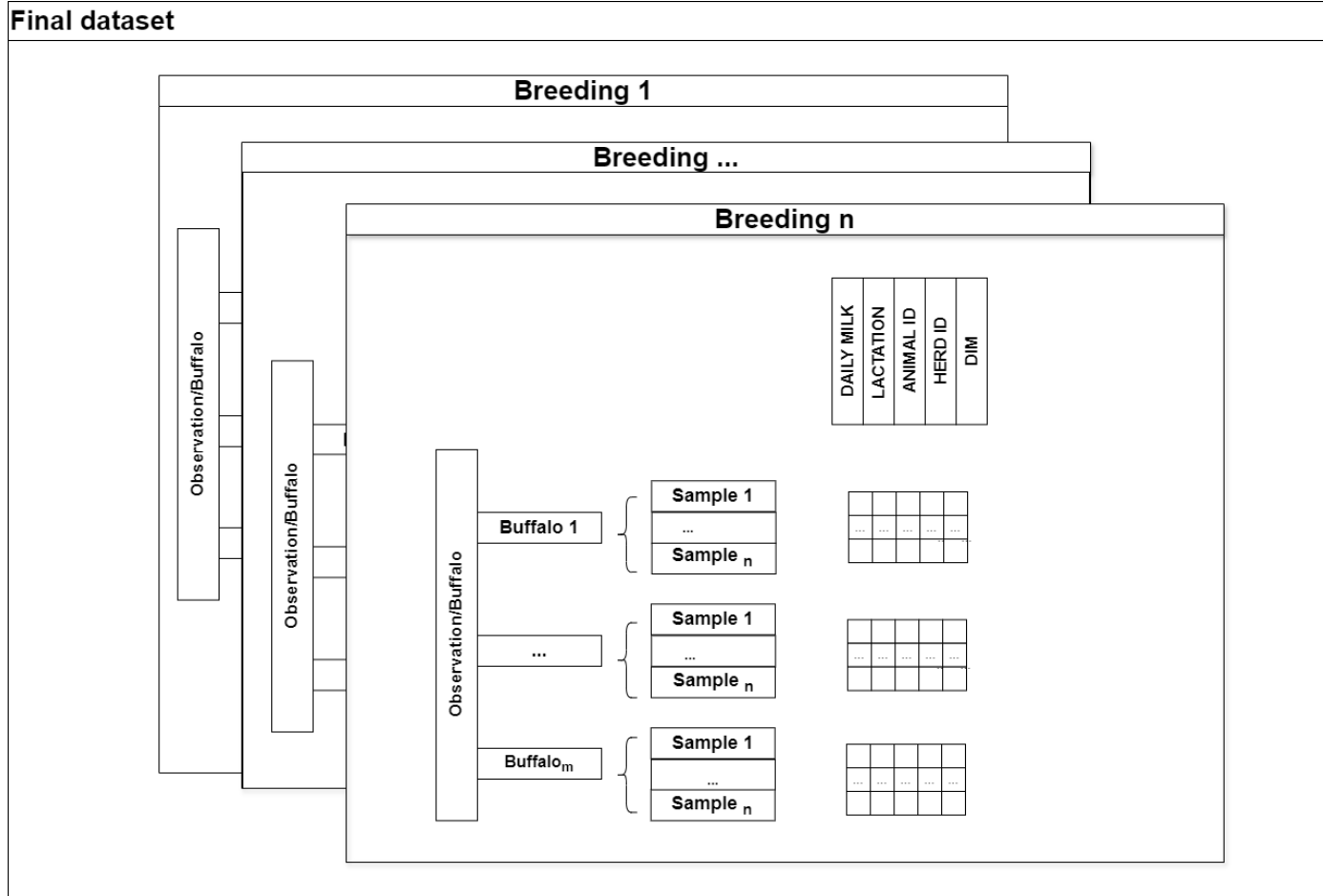
Aim of the work

- Increase in buffalo number per herd
- High request of buffalo milk

Require precision tools:
LC

The purpose of this work is providing evidence on how the Wood and Milkbot equations describe the buffalo LC

Dataset



Final dataset:

- 295 herds
- 33368 animals
- 377437 observations
- 5 numeric features

Equations

- Wood equation (Wood, 1967)

$$Y_w(t) = at^b e^{-ct}$$

- Y_w = milk yield,
- t = days in milk,
- a = magnitude,
- b = time to peak
- c = the decay.

- MilkBot equation (Ehrlich, 2013)

$$Y_{mb}(t) = a \left(1 - \frac{e^{\frac{c-t}{b}}}{2} \right) e^{-dt}$$

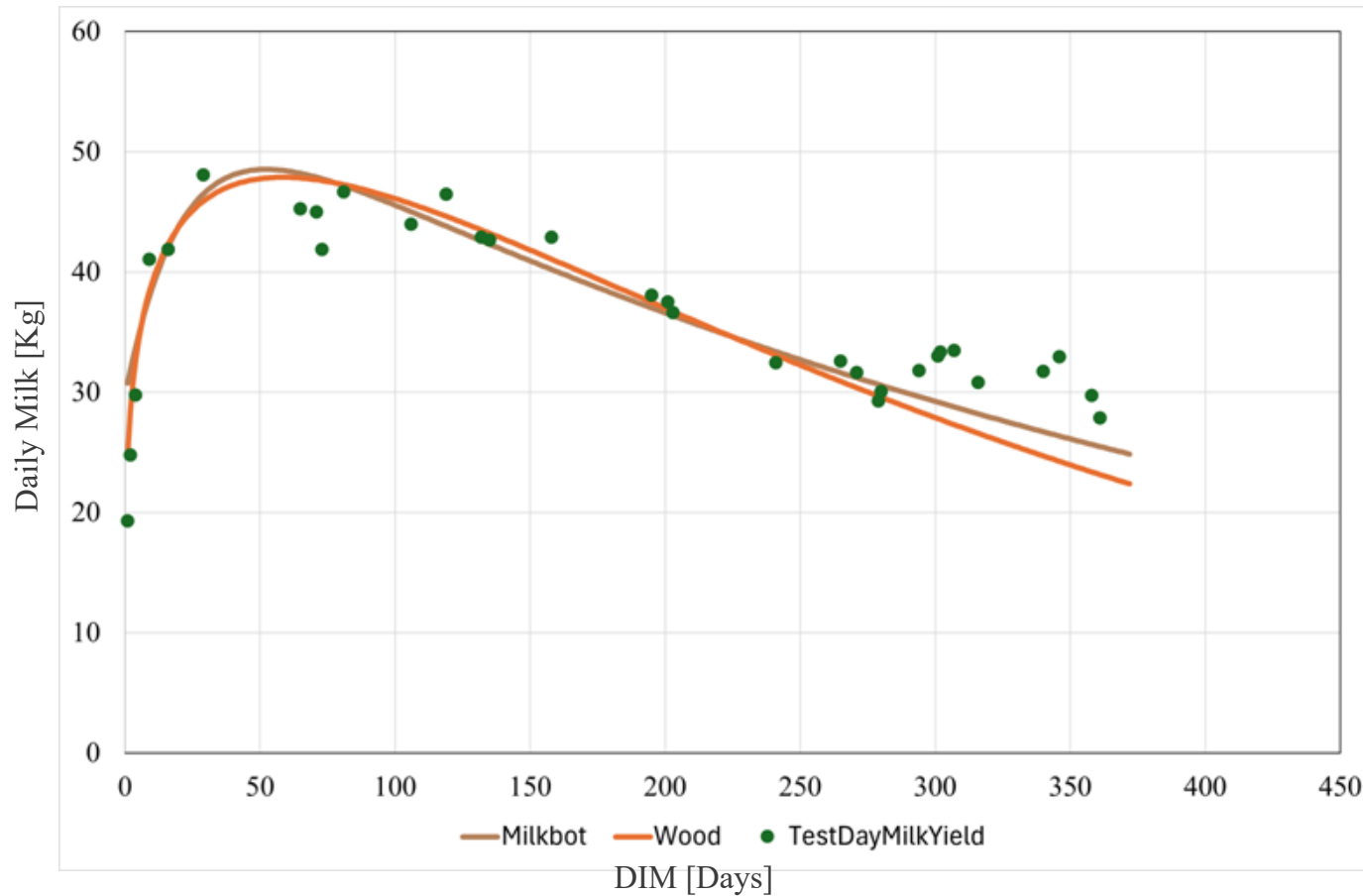
- Y_{mb} = milk yield,
- t = days in milk,
- a = magnitude,
- b = time to peak
- c = offset
- d = decay

Wood. (1967). Algebraic Model of the Lactation Curve in Cattle. *Nature*, 216 (5111), 164–165. <https://doi.org/10.1038/216164a0>

Ehrlich, J. L. (2013). Quantifying inter-group variability in lactation curve shape and magnitude with the MilkBot[®] lactation model. *PeerJ*, 1, e54. <https://doi.org/10.7717/peerj.54>

Equations

- Graphical comparison of Wood and Milkbot fitting



- The performance of the models was evaluated through the coefficient of determination (R^2)

$$R^2 = 1 - \frac{SS_{res}}{SS_{tot}}$$

where SS_{res} is the sum of the squared residuals and SS_{tot} is the total sum of squares

Results 1

Wood model

Parity	$\bar{a} \pm \sigma_a$	$\bar{b} \pm \sigma_b$	$\bar{c} \pm \sigma_c$	$\overline{R^2} \pm \sigma_{R^2}$
1	6.1±4.2	0.30±0.30	0.005±0.003	0.72±0.26
2	7.6± 5.1	0.29±0.30	0.006±0.004	0.78±0.22
3	7.9± 5.2	0.30±0.30	0.007±0.004	0.79±0.21

- The mean values of a , b , c are consistent with the literature *
- Good R^2 values especially for lactations 2 and 3
- The standard deviation for each parameter and R^2 suggest that data are strongly variable about the mean

Khan, Z., Pasha, T. N., Bhatti, J. A., Sharif, N. R. M., Sahin, T., Naveed, S., & Tahir, M. N. (2023). Fitting Various Growth Equations to the Daily Milk Yield Data of Nili-Ravi Buffaloes and Cholistani Cows at Intake at Maintenance Levels. *Kafkas Universitesi Veteriner Fakultesi Dergisi*.
<https://doi.org/10.9775/kvfd.2023.29278>

Results 2

Milkbot model

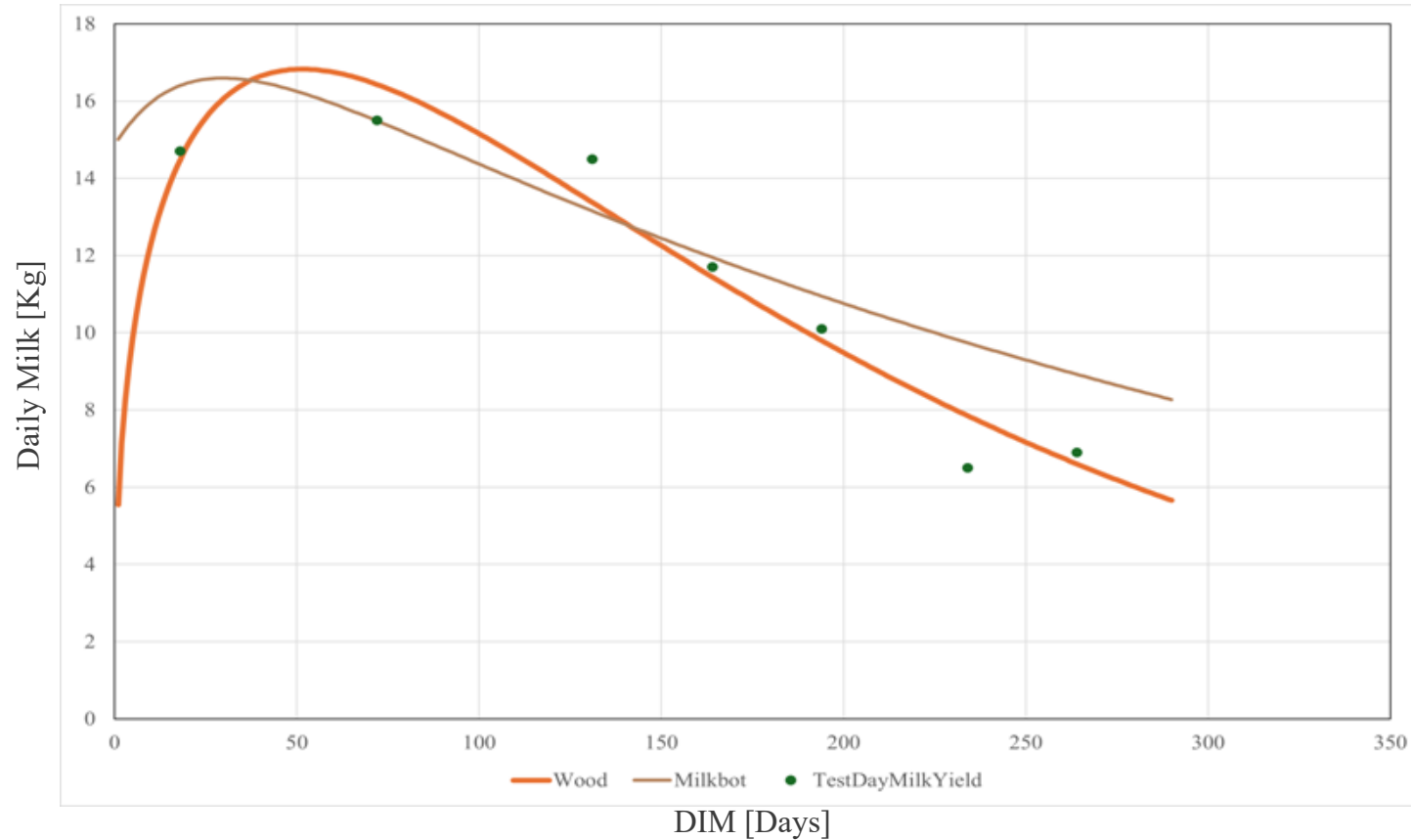
Parity	$\bar{a} \pm \sigma_a$	$\bar{b} \pm \sigma_b$	$\bar{c} \pm \sigma_c$	$\bar{d} \pm \sigma_d$	$\overline{R^2} \pm \sigma_{R^2}$
1	13.5±2.4	30.67±0.06	-0.4992±0.001	0.0015±0.000 1	0.58±0.26
2	15.9± 3.2	22.74±0.02	-0.7751±0.001	0.0026±0.000 3	0.69±0.22
3	17.1± 3.6	25.07±0.75	0.0039±0.002	0.0029±0.000 3	0.69±0.20

- Results seem consistent based on dairy cow parameters and their interpretation^{*}
- Milkbot performed worse than Wood in terms of R^2 for each lactation.

Chen, Y., Hostens, M., Nielen, M., Ehrlich, J., & Steeneveld, W. (2022). Herd level economic comparison between the shape of the lactation curve and 305 d milk production. *Frontiers in Veterinary Science*, 9. <https://doi.org/10.3389/fvets.2022.997962>

Results 3

- Fitting of the Wood and Milkbot models on buffalo milk samples



This is one of the first employment of Milkbot model on buffalo cows



The first lactations achieved worse result compared to the lactations 2+.

More efforts are needed to establish more accurate priors



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